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RABIES—ITS PREVENTION AND TREATMENT.

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The term rabies, or hydrophobia, is now applied to an acute, infectious malady transmissible from animal to animal. It has never been demonstrated that it ever does, or can, exist outside of the body, nor does it occur spontaneously. Its etiology and pathology can be no longer confounded with other diseases having like symptoms, owing to the researches and brilliant discoveries of Louis Pasteur.

Its distribution is general ; in almost all countries the malady is prevalent. Variations of temperature appear not to have any influence in checking or preventing its spread when once it gains a foothold. The chief agents in propagating this dreadful malady are the canine and feline species. Epidemics have, from time to time, broken out in various parts of the world, causing a large loss of life. In nearly all instances they have been traced directly to the dog as their origin.

It prevails, to a greater extent, in the civilized countries,—especially Europe. France, Spain, and Russia report the greatest number of cases in man. The mortality appears to be greatest in southern and south-eastern Russia,—where it is mostly contracted from epidemics occurring among wolves, which infest that country. The great number of cases occurring in that sparsely settled country are due, in part, to the manner in which the people live. The inhabitants are segregated in small villages, and a rabid animal entering one of these may play sad havoc before it can be killed, or make its escape.

In former times, rabies was very prevalent in Sweden and Germany, but now a case seldom occurs there, owing to the strict police regulations enforced for several years past. Australia is the only country known where the disease does not exist, and it will probably never gain a foothold there so long as their excellent quarantine regulations are in operation.

The popular idea, that the disease is one of hot countries, or that it occurs only during the summer season, is erroneous. From statistics gathered in France, where at present the disease is most prevalent, the months of December and May show the greatest number of cases. Much has been written during the past few years of this disease in Europe, and accurate statistics have been tabulated ; little or nothing has been said about the prevalence of the disease in this country ; it exists, and a great

number of cases occur yearly, both in man and among the lower animals. It is a lamentable fact that so little has been done by the medical profession in furnishing accurate reports of cases among persons affected with rabies. Occasionally an isolated case is reported by a medical man, but this appears to be the exception, not the rule. The most reliable information that can be had at present is from the daily press: although this is not an infallible source of information, especially on medical subjects, some heed must be given to its reports. During the last year, fully thirty cases have been submitted of persons dying affected with rabies. These occurring in cities and towns, it is safe to infer that fully as many more occur in the rural districts. We call to mind at least four cases, occurring in one neighborhood, that were not reported. The disease very frequently is not recognized because of the absence of the classical, if not mythical, symptoms, which the human subject is supposed to manifest.

Its distribution in the United States and Canada is general, no part of the country being exempt. In some localities the disease prevails to a greater extent among animals; these are, notably, northern Texas, New Mexico, and Arizona, where perpetuation is due to a species of the skunk family, *Mephitis mephitis*, this species of skunk being a small black animal having three white stripes down its back, and is about one half the size of those found in the Middle and Western states. It is the popular opinion that this animal never bites except when rabid, and that during certain seasons it is apt to become rabid, and will attack any creature it may encounter, even entering houses for this purpose. It is known in that section of the country as the hydrophobia skunk: its bite is usually followed, very shortly, by the disease. Generally, however, the origin and perpetuity of hydrophobia are among the canine species. The period of incubation varies from six days to over one year, the usual time being about forty days: it is a rare instance for the disease to manifest itself after six months have elapsed. The virus exhibits different degrees of intensity in different epidemics: sometimes the effect is delayed beyond the usual time, while in others it is much more speedily accomplished. When the disease is induced by inoculation into the cerebro-spinal canal, the effect becomes constant. "Street rabies" manifests such a wide variation in its period of incubation, that it invites inquiry as to the cause.

From a large number of experiments conducted by Roux in the Institute Pasteur, he found that to induce the disease in an animal the virus must find its way to a nerve, and through this channel reach the central nervous system. The rapidity upon which its action depends is in proportion to the size of the nerve, and the distance intervening between it and the brain: should only a small terminal filament of a distant nerve be wounded, a longer period of incubation will result. This explains why bites inflicted upon the head and upper extremities are so fatal. The virus must reach the central nervous system before the phenomena occur. Pasteur employs three methods of transmitting the disease,—1st, by intra-cranial inoculation; 2d, in the eye; 3d, in the deep muscles of the neck. A most curious

and important result was accidentally obtained during the inoculation from one to another of certain animals with rabic virus. When it was carried successfully through quite a number of monkeys (the first animals used), the virus in some way became so attenuated that immunity was conferred upon certain of the number: as this virus could only be preserved for a short time, Pasteur's attention was turned to the effects upon rabbits and other small animals. When the rabic material was introduced into the sub-arachnoidean space, the period of incubation became shorter and shorter on each passage; when it had passed through about seventy, the period became as short as six days, animals dying on the tenth or twelfth day. This virus has remained constant in its effects from that time until now, a period of over seven years; it forms the basis of preventive inoculation, and is termed "virus fixe;" it has reached its 292d passage. This line of experimentation has been crowned with long-hoped-for success, and made his wonderful treatment for prevention possible. The virus appears to be intensified by this procedure, and promises to be constant in its effects for an indefinite period. The symptomatology of rabies, whether produced artificially or from a bite, is the same, differing in degree only. In animals, where the sensory nervous system is highly developed, there are more disturbances manifest during the first stage;—examples, man, horse, and dog.

There are three stages of the disease,—1st, excitement of both motor and sensory systems; 2d, incoördination; 3d, paralysis. The pneumogastric is profoundly afflicted from the beginning. At what stage of incubative process does the animal become dangerous? Roux has satisfactorily demonstrated that before any symptoms of rabies are apparent in an animal, the saliva becomes virulent, usually two or three days before the first symptom. At the time it becomes virulent, there is an increase of usually a degree or more in the body temperature. When this occurs, the peripheral nerve terminals are stimulated in some way, and the secretions of salivary and lachrymal glands eliminate this peculiar poison: this can, in part, be accounted for, owing to the peculiar nerve termination within the specific cells of these glands, which appear to be modified nerve protoplasm. Recognition of the disease objectively is not an easy task, whether in man or beast, especially in the first and second stages. In suspected cases, occurring in dogs, the animals must be held under observation until the disease has fully declared itself. Another method, and the one most practised, is to kill the dog, if suspected, examination being made by inoculation of some portion of the nervous system into smaller animals. But this last procedure cannot be recommended in event of a person's having been bitten, for then it becomes an absolute necessity to determine at the earliest moment whether or not the animal is rabid. If the third stage of the malady is present in the animal, little or no difficulty will be encountered in demonstrating the disease. An examination of the dog's stomach will be found amply sufficient to clear away any doubt. The pathological changes found post mortem

are few. Aside from characteristic lesions found in the stomach, and a congestion of the spinal meninges of the brain and cord, there is nothing pathognomonic. Some observers have noticed that in the induced rabies, there is a slight suppurative process found in the meninges; this, evidently, was from accidental infection, and not from the disease itself. The cause, whatever it may be, is located in the nervous system, and is excreted by certain glands. Its life history points to the existence of a micro-organism. Its behavior in the presence of inert gases is identical with anærobic bacteria. The virulence can be preserved indefinitely in vacuo, or atmosphere of hydrogen, nitrogen, or carbon dioxide. It is rapidly destroyed by oxygen, or by drying in the air; it is highly sensitive to heat, especially after having been removed from the body; owing to its strictly anærobic properties it does not exist in the blood.

Prophylaxis.—This disease is so wide-spread in our country, that active measures should be taken to eradicate it. Such a result is not impossible, as has been demonstrated in countries wherein at one time the disease was prevalent, but is now a rarity. Germany, Switzerland, and Sweden have almost completely overcome it by their strict quarantine regulations, and orders for muzzling all dogs. Germany at one time suffered severely from its ravages, on account of the peasantry keeping a large number of dogs which they used as beasts of burden; and their intimate association with these was a frequent source of rabic infection. The muzzling order has now been in effect for the last decade, and has been the means of completely banishing it from within the borders of the state. Sweden prohibits the importation of dogs, and thereby diminishes her liability to the disease.

Australia has had for many years a wise provision in her public health laws regulating the importation of dogs. No dog can be landed in that country until it has been quarantined for six months, a period covering the time of incubation in the larger proportion of rabid dogs. Compulsory muzzling should be the rule everywhere until the same result has been obtained as in Germany. Nearly all the municipalities have at some time passed ordinances concerning the taxing, confining, or muzzling of dogs. These statutes, so far as the average American is concerned, are dead letters: little or no heed is paid to them, and they are forgotten by the officials, who, as a rule, are more interested in politics than in public health or sanitation. Sometimes, when a case does occur, and with it perhaps a loss of human life, the officials bestir themselves in their officialism, issue proclamations for muzzling dogs, etc., then relapse into the same old rut as of yore. What is the cause of all this? Can it be that these people who are in charge of our local government are wilfully careless of the laws of preservation of the human life and health entrusted to their care? On the contrary, they are willing to be advised, and wish to do whatever is necessary, provided they have moral support. The medical profession must take the initiative, and direct in all such matters; without a faithful coöperation of medical men, the authorities can never accomplish much in sanitary legis-

lation. To medical men and to the authorities of cities and towns belongs the work of educating the people at large in the matter of properly understanding the gravity of such a malady, and of taking initiatory steps for bringing about a general harmonious action for thorough legislation on this important subject. The sooner it is understood that rabies is a disease as well established in its pathology as any of the acute exanthems, and when there is less reliance placed in cauterizations and the celebrated "mad stone" for the cure of rabies, and a proper appreciation of more rational treatment, the mortality will be proportionately lessened. The methods applicable to our country are,—

1. Quarantine of all imported dogs ;
2. General muzzling of all dogs ;
3. Preventive treatment of the disease in men.

The preventive treatment at the Institute Pasteur is fraught with most brilliant results. Since the commencement of the treatment in 1886, the mortality has steadily declined as the methods have become better understood. Another factor of success is, that the medical profession of France properly appreciate the importance of preventive treatment being undertaken as early as practicable. The disease is quite prevalent in France and Belgium, but no restrictive measures have as yet been taken in muzzling their dogs. The Institute Pasteur, established now for four years and built entirely by public subscription, is a lasting monument to the wonderful discoveries of its founder. That this institution receives an annuity from the state is the greatest tribute of appreciation ever paid to any man who has allied himself to the medical profession.

Similar institutions for the treatment of rabies have been established in various countries : In Russia, 7 ; Italy, 5 ; Spain, 1 ; Austria, 1 ; Hungary, 1 ; Cuba, 1 ; Brazil, 1 ; Argentine Republic, 1 ; Mexico, 1 ; England, 1 ; United States, 2—a total of twenty-one places where treatment can be had against rabies. Statistics issued from the Institute Pasteur are as correct as statistics can be made.

Cases coming for treatment are divided into three classes, designated as A, B, and C.

Class A comprises those bitten by undoubtedly rabid animals, demonstrated so experimentally ; class B, Cases affirmed by a veterinary certificate that the animal was mad ; Class C, Patients bitten by animals suspected of rabies.

It is further required that in all cases practicable a specimen of the nervous system, brain, or spinal cord should accompany each case. Over fifty per cent. of the cases classed A, B, and C are accompanied with specimens, and eighty per cent. of these are from rabid animals. Thus it is readily seen that a large proportion of the cases have been actually exposed to infection ; and, if comparison be made with older statistics, it will be conclusively shown that there exists a wide difference in the rate of mortality.

Statistics since the Institute has been opened are as follows :

Year.	Number cases.	Deaths.	Percentage of mortality.
1886	2671	25	.94
1887	1770	13	.73
1888	1622	9	.55
1889	1830	6	.33
1890	1546	5	.32

In similar institutes furnishing similar tables of mortality, the ratios are the same as those given above. In Buda-Pesth during the last year the percentage of mortality was slightly lower than at Paris, and most of the cases had contracted rabies from rabid wolves, which are far more dangerous than ordinary dogs.

METHOD OF TREATMENT.

The principle involved in preventive inoculation is to induce a mild attack of the disease in a comparatively short time, before the primary inoculation has had time to take effect; then, before the primary virus reaches the brain, the system is rendered immune by the secondary inoculation. The mortality is due to two causes,—1, to delay of preventive treatment; 2, to bites about the head and face, where the distance is so short between the injured nerve and the brain that the virus traverses the nerve and reaches the brain before any protective effect can be had from the inoculations. Treatment consists in inoculating the person with a minute portion of attenuated virus from day to day, each day becoming stronger and stronger, until, at last, all but the intense virus is used. A series of rabbits is inoculated with the virus size, which kills them with the utmost regularity. The spinal cords are removed—all precaution being taken against infection as soon after death as possible—and are suspended in sterilized bottles, the bottoms of which contain a quantity of caustic potash or soda. The series of cords, twelve in number, is always kept on hand owing to the fact that one cord is thus prepared from day to day. These are placed in a room especially prepared for the purpose, and kept constantly at 23° C. The preparation of the cord is as follows: A small portion which has been dried for a certain number of days, is rubbed up in sterile conical flasks by means of glass rods, and an emulsion made by the addition of ordinary sterilized bullion of $\frac{1}{10}$ per cent. strength,—2 c. c.'s to each dose, which is one half of the cord. A series of cords is thus prepared, comprising those of the fourth to the sixteenth day's drying. For inoculation of patients the following method is used:

First day's treatment, 2 c. c. each of emulsion of cord dried 15–16 days.

Second day's treatment, 2 c. c. each of emulsion of cord dried 14–13 days.

Third day's treatment, 2 c. c. each of emulsion of cord dried 12–11 days.

Fourth day's treatment, 2 c. c. each of emulsion of cord dried 10–9 days.

Fifth day's treatment, 2 c. c. each of emulsion of cord dried 8-7 days.
Sixth day's treatment, 2 c. c. each of emulsion of cord dried 7-6 days.
Seventh day's treatment, 2 c. c. each of emulsion of cord dried 6 days.
Eighth day's treatment, 2 c. c. each of emulsion of cord dried 6 days.
Ninth day's treatment, 2 c. c. each of emulsion of cord dried 6 days.
Tenth day's treatment, $1\frac{1}{2}$ c. c. each of emulsion of cord dried 5 days.
Eleventh day's treatment, $1\frac{1}{2}$ c. c. each of emulsion of cord dried 5 days.

Twelfth day's treatment, 2 c. c. each of emulsion of cord dried 6 days.
Thirteenth day's treatment, 1 c. c. each of emulsion of cord dried 6-5 days.

Fourteenth day's treatment, 1 c. c. each of emulsion of cord dried 5-4 days.

Fifteenth day's treatment, 1 c. c. each of emulsion of cord dried 4 days.
Sixteenth day's treatment, 1 c. c. each of emulsion of cord dried 4 days.

Seventeenth day's treatment, 1 c. c. each of emulsion of cord dried 3 days.

Eighteenth day's treatment, $1\frac{1}{2}$ c. c. each of emulsion of cord dried 3 days.

For cases bitten about the upper extremities, head, and face, a more intense treatment is practised. Gamalia recommends it for the treatment of those bitten by wolves. The inoculations have never as yet caused any disturbances in those not affected. It is quite certain that in Class C many take the treatment who have never been exposed to rabies. All assistants of the institute have been inoculated, and none have suffered in any way therefrom. The apology offered for calling attention to this subject is, that so far not enough importance has been attached to it by the medical profession in America. Moreover, the wonderful success which has been achieved by the illustrious Pasteur in treatment of this disease, marks an era in preventive medicine. The disease is here widely distributed. Cases are occurring from time to time, and apparently increasing numerically. Should not concerted measures be taken to check its progress? Would it not strengthen our position in other matters pertaining to preventive medicine in general?

Here we rest our case.